MANAGING ROAD TRANSPORT RISKS
— Sustainable Safety in the Netherlands —

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In the Netherlands, as in most other countries in the world, car mobility is increasing rapidly. The accident rates are decreasing, but the decrease is not large enough to compensate for the extra road traffic victims brought about by the increased mobility. Without strong, innovating efforts the number of road traffic victims will increase and the Dutch road safety targets (minus 50% fatalities and minus 40% serious injuries in 2010 compared to 1986) will be out of reach. Therefore, in the early nineties the concept of "sustainable safety" was introduced with the aim to give road safety a new impulse. In a sustainably-safe traffic environment, road infrastructure is, first and for all, designed in such a way that the chance of an accident occurring is very limited. Secondly, if an accident cannot be prevented, the chance of serious injury will be markedly reduced. A very important characteristic of a sustainably-safe traffic system is that all relevant characteristics of infrastructure, vehicle and traffic regulations are maximally tuned to the capabilities and limitations of the road users as well as their acceptance of the measures. The article discusses the sustainable safety principles and measures and the organisational and financial framework. It also provides an estimate of the expected benefits in terms of road traffic fatalities. It is estimated that a successful implementation of sustainable safety measures could indeed result in the targeted 50% reduction in road traffic fatalities, even when the number of vehicle kilometres double. The use of quantitative road safety targets is considered to have created a positive, open climate for these types of new and innovating policies.

Key Words: Sustainable road safety, Network planning, Road design, Road accident risk, Road safety targets

1. INTRODUCTION

In an international perspective, the road safety situation in the Netherlands is fairly good. The Netherlands belong to the top 5 of safest European countries. Nevertheless, with a population of around 16 million, the Netherlands currently face over 1,000 road transport fatalities and over 18,000 hospitalised traffic injuries annually. In the second half of the eighties the numbers were still considerably higher: over 1,500 fatalities and around 22,000 hospitalised traffic injuries. The total number of road traffic victims (fatalities, serious and slight injuries) is more or less stable at around 50,000 annually. These numbers were considered much too high, which was one of the reasons that in 1989 the Dutch government introduced quantitative road safety targets. The targets were ambitious, but thought to be feasible: minus 50 per cent fatalities and minus 40 per cent serious injuries in 2010 compared with 1986. In absolute numbers this would mean 750 fatalities and 13,000 serious injuries in 2010. A number of spear-head road safety actions were defined aiming to contribute to the realisation of the targets. The spear-head actions focused, among other things, on drink driving, speeding, residential areas, young car drivers, seat belt use and moped riders.

Whereas the approach was effective and contributed to the decrease in accident risk on all types of road[1], the decrease was not large enough to compensate for the extra road traffic victims brought about by increased mobility. Calculations determined that continuing the chosen line of approach would not produce the targeted safety results and it became clear that strong, innovative measures were required to bring the road safety targets into reach. That was the immediate reason that in the early nineties the concept of sustainable safety was developed, aiming at a traffic system that is inherently safe, a traffic system where the chance of an accident occurring and the chance of serious injury is very limited.

2. THE CONCEPT OF SUSTAINABLE SAFETY

The aim of sustainable safety is to create a traffic system and traffic conditions in which the probability of an accident is limited in advance by means of an inherently safe road environment. Where accidents still occur, the conditions of the road, the road-side and the vehicle are such that serious injury is virtually excluded[2]. In a sustainable safe traffic environment the road user is the starting point. All elements of the traffic system are maximally tuned to the capabilities and limitations of its users, not only the average 40 year old car user, but also special groups of users such as children and the elderly. The road network and road infrastructure are easy to understand and predictable, and more or less automatically elicit the required, safe behaviour. Vehicles are made and equipped in such a way that the human task is simplified and human error less probable and less disastrous. Furthermore, the road users are adequately educated, informed and, where still necessary, controlled.

A sustainably-safe road traffic system is based upon three key safety principles: functionality, homogeneity and predictability.

Functionality refers to the use of the road network. The road network has to consist of a small number of road types or road categories with each category having its own and exclusive function with its own and exclusive requirements regarding use and behaviour, easy to understand and to comply with for all types of road users. In a sustainable safe traffic system three traffic functions are distinguished: the flow function, a through road for long distance travel, at high speeds and, generally, for high volumes; the distributor function, serving districts and regions containing scattered destinations; and the access function, enabling direct access to properties alongside a road or a street.

Contrary to the common practice of today in a sustainably-safe traffic system a road is only monofunctional and not multifunctional (see Table 1).

Homogeneity refers to the prevention of large differences in speed, mass and direction. For example, roads with a flow function enabling high speeds for motorised traffic are closed for agricultural vehicles since speed differences are too large. They are also closed for bicycles, since both speed and mass differences are too large. Opposing traffic streams are separated in order to avoid accidents between vehicles from opposing directions. The homogeneity principle reduces the need and possibility for complex manoeuvres.

Predictability, the third key principle of a sustainably-safe traffic system, is directly related to the road user. The layout and design of the road network and the individual roads in the network are clear and unambiguous and prevents uncertainties amongst road users. Road users immediately recognise the type of road they are travelling on; they know its function, they know what other types of road users and type of behaviour they may expect and how they themselves should behave. The prevention of uncertainty also refers to the consistency of design along a particular stretch of road, avoiding, for example, unexpected narrow bends and an unexpected road narrowing. The latter is a well known principle in designing for safety[4].

Whereas network planning and road design principles are the main components in the concept of sustainable safety, measures directed at the road user and the vehicle are necessary when aiming to optimise and enlarge the effects of the infrastructure measures. In a sustainably-safe traffic system the number of different types of vehicles should be kept to a minimum and each type should be easily recognised and is predictable in terms of its performance and behaviour characteristics. Furthermore, conventional passive safety features such as crushable zones and forgivable front-end design, fit in well in the sustainable safety philosophy. Their use does

Table 1 Common practice and sustainable safe practice of categorising roads and streets (from: 3)

Common practice of today			Sustainable safe practice
Existing types of roads	Traffic function	Traffic function	Sustainable safe types of roads
Motorway	↑ increasing through and decreasing access	Through	Ia. Motorway
Motor road			Ib. Motor road
Main distributor		or	IIa. Distributor road (rural)
Local distributor		Distributor or	IIb. Distributor road (urban)
District artery	↓ decreasing through and increasing access		IIIa. Access road (rural)
Neighbourhood artery		Access	
Residential street			IIIb. Access road (urban)
Woonerf			
	Residential function	Residential function	

not depend on the motivation and capabilities of the driver and they help to mitigate the injury consequences of an accident for both the car occupants and the other party[5]. When looking at accident avoidance, there will be an increasing role for new technologies and intelligent in-vehicle devices, such as intelligent speed adaptation, intelligent warning systems and anti-collision systems.

The road user, the key player in every road traffic system, has to be informed and educated to understand the aims and the product of sustainable safety as well as its consequences for his or her mobility, travel pattern and behaviour. Sustainable safety automatically means a rather severe restriction in the individual freedom of road users. It will take time and effective 'marketing' to convince them and to achieve overall acceptance[6]. In short, creating sustainable safety in road traffic requires an integrated approach.

3. FROM PRINCIPLES TO SAFETY MEASURES

The general concept of sustainable road safety as described in the preceding section was developed and elaborated in the early nineties[2] and adopted in the Dutch national policy on road transport and road safety in 1996[7,8]. The main challenge then was to convert the largely theoretical notions into functional requirements and operational criteria for actual design. In 1997 preliminary guidelines were prepared by a working group consisting of national experts on safety, network planning, road design and human behaviour[9]. The preliminary guidelines were developed further and, currently, the national guidelines for the design of roads outside urban areas are being revised to incorporate the sustainable safety principles.

The functional requirements for a sustainable safe road network were formulated as follows:

1. Realise residential areas that are as large as possible.
2. Minimal part of trips over unsafe roads.
3. Trips as short as possible.
4. Shortest and safest route are the same.
5. Prevent searching for destinations.
6. Make road categories recognisable.
7. Reduce the number of traffic solutions and make them uniform.
8. Prevent conflicts with oncoming traffic.
9. Prevent conflicts with crossing traffic and pedestrians.
10. Separate different means of transport.
11. Reduce speeds where conflicts could occur.
12. Avoid obstacles along the road.

The functional requirements were developed further into draft general guidelines. Tables 2 and 3 show some guidelines for the three sustainable safe road categories

Table 2 General guidelines for design of the sustainable safe road categories outside built-up areas (from 9)

Design criteria	Roads outside built-up areas		
	Through road	Distributor road	Access road
Speed limit	120/100 km/h	80 km/h	60 km/h
Longitudinal marking	Complete	Partly	No
Cross section	2 × 1 (or more)	2 × 1 (or more)	1
Road surface	Closed	Closed	Open
Access control	Yes	Yes	No
Carriageway separation	Yes, physical	Yes, visual, to be crossed over	No
Crossing between junctions	At grade	At grade	Grade
Parking facilities	No	No	Parking space or on the carriageway
Stops for public transport	No	Outside the carriageway	On carriageway
Emergency facilities	Emergency lane	In verge or on hard shoulder	No
Obstacle free zone	Large	Medium	Small
Cyclists	Separated	Separated	Depending
Mopeds	Separated	Separated	On carriageway
Slow motorised traffic	Separated	Separated	On carriageway
Speed reducing measures	No	Appropriate measure	Yes

Table 3 General guidelines for design of the sustainable safe road categories inside built-up areas (from 9)

Design criteria	Roads inside built-up areas		
	Through road	Distributor road	Access road
Speed limit		70/50 km/h	30 km/h
Longitudinal marking		Partly	No
Cross section		2×1 (or more)	1
Road surface		Closed	Open
Access control		No/limited	Yes
Carriageway separation		To be crossed over	No
Crossing between junctions		At grade	Grade
Parking facilities		No	Parking space or on the carriageway
Stops for public transport		Outside the carriageway	On carriageway
Emergency facilities		In verge or on hard shoulder	No
Obstacle free zone		Medium	Small
Cyclists		Separated	Depending
Mopeds		Separated/on carriageway	On carriageway
Slow motorised traffic		On carriageway	On carriageway
Speed reducing measures		Yes	Yes

(through roads, distributor roads and access roads) outside and inside built-up areas respectively.

The further elaboration of the general guidelines into guidelines for individual design elements is relatively straightforward when looking at through roads and access roads. With regard to the distributor roads the situation is less clear and causes much discussion about what is theoretically desirable and practically feasible. A distributor road has a flow function at the road stretches and an access function at the intersections. This means that at intersections all types of traffic have to mix and, hence, that speeds have to be low. Roundabouts are a good solution. At road stretches higher speeds are allowed, hence requiring strict separation of different types of road users (motor vehicles; agricultural vehicles; bicycles/mopeds), separation of oncoming traffic streams, and no direct access from properties. This asks for parallel roads and cycle lanes which both from a financial point of view and from a land use point of view are not easily realised. When aiming at sustainable safety, halfway solutions such as assigning a mixed function instead of a monofunction to this type of road should be avoided. Discussions are ongoing, focusing on the question to what extent non-ideal solutions are acceptable in a transition situation.

Overall, the sustainable safety approach and the resulting road infrastructure measures and redistribution of mobility are expected to have a substantial effect on the number and severity of road accidents. Whereas many of the elements and principles are not new in themselves, the power of sustainable safety is in a consistent application, network-wide. The three most effective individual elements of the programme are considered to be:

1. A limited number of monofunctional road categories with a consistent and unambiguous design and layout. This enables road users to generate, for each road category, the correct expectations about the road and traffic conditions, the presence and behaviour of other types of road users and the requirements about their own behaviour;
2. The reduction of differences in speed and mass by separating pedestrians, bicycles, mopeds and agricultural vehicles from fast motorised traffic on roads with a flow function and by substantially reducing the speed of motorised traffic on roads and junctions where road user categories have to mix (access roads and junctions between access roads and distributor roads). These measures will affect the number and seriousness of accidents between motorised and non-motorised traffic, which currently account for approximately 50 per cent of the injury accidents inside built-up areas and over 25 per cent of the injury accidents on non-motorway rural roads.
3. The realisation of the obstacle free zones and related road-side safety measures, in particular on through roads and rural distributor roads. These measures will affect the number and seriousness of single

motorised vehicle injury accidents, which currently account for over 25 per cent of the injury accidents on roads outside built-up areas and around 8 per cent on roads inside built-up areas.

A quantified estimate of the effects of sustainable safety measures in terms of fatality rates and, taking account of the expected mobility growth, on the number of fatalities is provided in the next section.

4. ESTIMATES OF THE EFFECTS OF SUSTAINABLE SAFETY ON ROAD TRAFFIC FATALITIES

As stated in the introduction extra efforts such as the implementation of the sustainable safety principles are required to bring the national road safety targets into reach. In the period 1986–1998 the Netherlands registered an almost stable number of 50,000 road traffic victims (fatalities, serious and slight injuries) annually. A number of characteristics of the road network in the Netherlands in the year 1998 is presented in Table 4, for reference purposes. The current road types are grouped together as such, so that they comply with the functional classification of roads according to the sustainably-safe road traffic system:

- through road: currently mainly motorways;
- rural distributor road: currently provincial roads without bicycle and pedestrian traffic;
- rural access road: currently all other rural roads;
- urban distributor road: currently the major, urban roads;
- urban access road: currently streets with houses, shops, businesses etc.

Whereas the number of victims remained more or less stable between 1986 and 1998, in the same period car mobility increased by around 40 per cent. Consequently, the fatal and injury accident rate decreased. Conventional safety measures such as spear head actions directed at high risk road user groups, high risk behaviour and high risk traffic situations as well as passive safety measures, are a likely explanation for the accident rate reduction in this period. The accident data show that the reduction of the fatality rate is larger than the reduction of the injury rate. Between 1973 and 1985 the fatality rate per billion vehicle kilometres decreased by an average of 9 percent annually. After 1985, however, the fatality rate reduction became smaller with, on average, 5 per cent per year[1].

However, car mobility will continue to increase and the effects of the conventional safety measures are likely to continue to decrease. Assuming a similar development in the forthcoming years, car mobility will be 45 per cent higher in 2010 compared with 1998. The largest increase and the largest share of car mobility is expected to occur on the relatively safe through roads with a flow function,

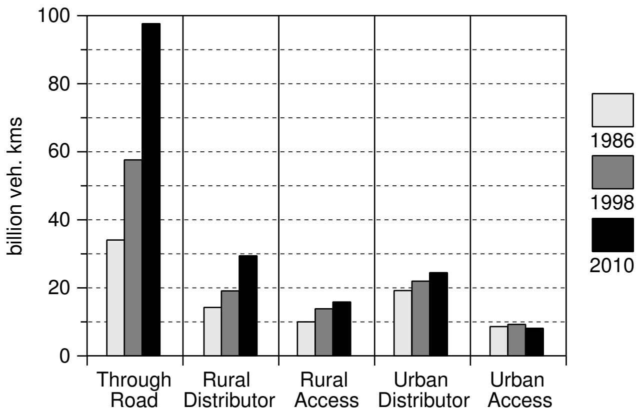

Fig. 1 Car mobility on different road categories in the Netherlands in billion vehicle kilometres in 1986, 1998 and (estimated) in 2010

Table 4 Percentage division of road lengths, car kilometres, injury accidents, in-patients, and road fatalities by road type of the Netherlands road network in 1998

	Road length (%)	Million car-kilometres (%)	Injury accidents (%)	In-patients (%)	Road fatalities (%)
Through Road	4	49	8	12	19
Rural Distributor Road	6	15	9	14	18
Rural Access Road	40	11	15	19	29
Urban Distributor Road	13	7	13	12	6
Urban Access Road	35	7	13	12	6
Total	100	100	100	100	100

i.e., the current motorways. Figure 1 visualises the developments. If the fatality rate and the seriousness of the injury consequences of accidents do not decrease further, the increase in mobility will result in 30 per cent more fatalities in 2010 compared with 1998. The number of fatalities would then be back to the level of 1986. If, in addition, the distribution of the extra mobility would be equally divided over each of the road categories and not mainly to the safest type of road, as depicted in Figure 1, the number of fatalities would increase with the same percentage as the car mobility, i.e., 45 per cent. Whereas the latter is not a very realistic scenario, it shows that measures which redirect vehicles to lower order rural roads have strong negative side effects on road safety.

With the implementation of sustainable safety, a new impulse is given considerably to reduce the accident

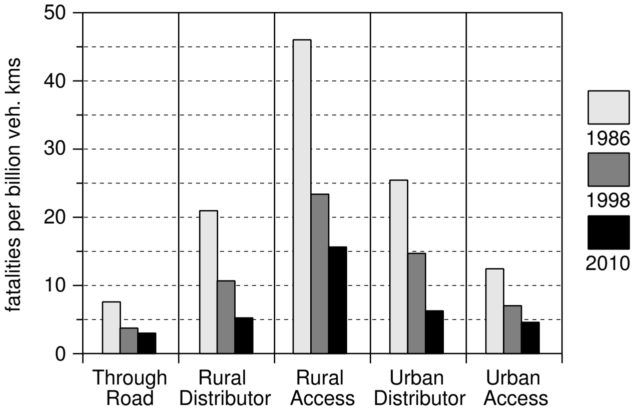

Fig. 2 Fatality rates per billion vehicle kilometres for different road categories in the Netherlands in 1986, 1998 and (estimated) 2010

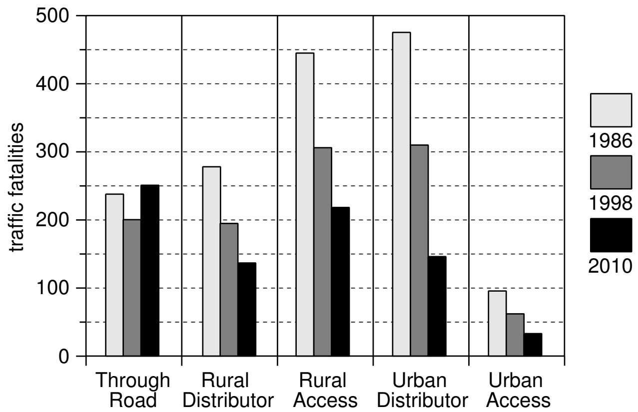

Fig. 3 Number of fatalities on different road categories in 1986, 1998 and (estimated) in 2010

rates on all road types to avoid the scenarios discussed above to become true. What may be expected of the sustainable safety measures and will it be sufficient to achieve the road safety targets in 2010?

Figure 2 shows fatality rates on different road categories per billion vehicle kilometres in 1986, 1998 and gives an estimate of the fatality rate in 2010. The method and main assumptions for estimating the potential effects on the fatality rates are explained further below. Figure 3 shows the resulting number of road traffic fatalities in each of these years. It becomes clear that during the period 1986-1998 the fatality rates on all road categories decreased to such an extent that, in spite of an increase in car traffic of 40 per cent, the number of road fatalities decreased by 30 per cent. Up to the year 2010, the decrease in fatality rates is expected to continue, assuming only a part realisation of the sustainable safety measures. If car traffic growth cannot or is not desired to be stopped, a substantial reduction in victim rates is conditional for achieving the road safety targets.

The measures, proposed within the framework of sustainably-safe, have the potential of a considerable decrease in victim rates for all road types, as indicated in the preceding section. For estimating the potential reduction of the fatality rate in 2010, a distinction is made between road stretches and crossroad measures. For each of the five road types a further distinction is made for injury accidents by those with: only fast, motorised traffic (commercial vehicles, buses, cars, and motorbikes), only slow, non-motorised traffic (mopeds, bicycles, and pedestrians), and a combination of fast and slow traffic. A separate group are the single motor vehicle accidents, because of their high share of severe accidents (sometimes more than 40 per cent). Table 5 shows that the division of injury accident types differ for the different road categories in 1998.

Table 5 Division of injury accident types by the Netherlands road types in 1998

	fast v. fast (%)	fast, single vehicle (%)	fast v. slow (%)	rest (%)	total (%)
Through Road	54	34	6	6	100
Rural Distributor Road	36	20	24	20	100
Rural Access Road	21	31	29	19	100
Urban Distributor Road	28	8	47	17	100
Urban Access Road	22	7	56	15	100

Through sustainably-safe measures particular accident types are prevented or made less severe. For example, for through roads and distributor roads the most important aim is to prevent accidents between fast and slow traffic. Where conflicts between fast and slow traffic are unavoidable, such as on access roads, speed reduction measures will considerably reduce their severity. Expressed in terms of rates, this means, on the one hand, reducing the number of injury accidents per vehicle kilometre by eliminating certain accident types; and on the other hand reducing the number of fatalities per injury accident (accident severity) as a result of reducing driving and crash speeds.

By using the division of injury accident types by Netherlands road types in 1998 from Table 5, the potential effect of sustainably-safe measure on the accident reduction, is estimated for the year 2010. Table 6 shows the resulting reduction in percentages of the injury accident rates and the accident severity rate. The percentages are based upon the assumption that up to the year 2010, the sustainably-safe measures will focus on the reduction of accidents between fast and slow traffic.

In Table 7, by way of illustration, the 2010 estimation of the potential effect of the sustainably-safe measures is specified for rural distributor roads. Estimations for the other road categories can be found in[10].

The most important measures along rural distributor road stretches are:

1. Introduction of parallel or alternative facilities for slow traffic and local traffic, so that only motorised through traffic drives on the main carriageway. It is assumed that in 2010 approximately 80 per cent of the total length of this type of roads (7,000 km) will have been treated in this way.
2. Separation of driving directions in combination with a speed limit of 80 km/h, so that overtaking no longer happens, and driving speeds are lower and more homogeneous. It is assumed that in 2010 around 50 per cent of the total length will have been treated in this way.
3. Improvement of the road-side safety by creating obstacle free zones, aiming to affect accident severity. It is assumed that 50 per cent of the total length will have been treated in this way in 2010.

Table 6 Reduction percentages of the rates and severity of injury accidents on the Netherlands road types through sustainably-safe measures in 2010 compared to 1998

	Reduction of the number of injury accidents per million motor vehicle kilometres (%)	Reduction of the number of fatalities per 100 victims (%)
Through Road	19	10
Rural Distributor Road	44	20
Rural Access Road	19	20
Urban Distributor Road	54	10
Urban Access Road	24	20

On crossroads of rural distributor roads, speed reduction measures will be taken to make it possible to cross with slow traffic. The roundabout is the most suitable type for crossroads with four branches. It is recommended that only turning right should be permitted on crossroads of three branches. In order to estimate the potential effect on the number of accidents, it is assumed that in 2010 some crossroads will be eliminated and that most of the remaining crossroads will have been replaced by roundabouts.

Based on these assumptions it is estimated that the potential injury accident reduction on rural distributor roads is 43 per cent for road stretches and 45 per cent for crossroads in 2010 compared to 1998, which, in total, equals 44 per cent (see Table 6). Because of reduced speeds and increased road side safety, the accident severity (number of fatalities per injury accident) will be reduced by 20 per cent (see Table 6).

The effect of sustainably-safe for the year 2010 is, for the time being, expected to be modest. Nevertheless, with 45 per cent more car kilometres during the period 1998–2010 and the already-mentioned rate reductions per road type, the annual number of road fatalities in the Netherlands will be about 770. The target of 50 per cent less than in 1986 will just be achieved. The expected reduction for all

Table 7 Reduction percentage of injury accidents on the Netherlands rural distributor roads through sustainably-safe measures in 2010 compared to 1998

Injury accidents on rural distributor roads	fast v. fast (%)	fast, single vehicle (%)	fast v. slow (%)	rest (%)	total (%)
Road stretch (share 60%)	45	40	60	20	43
Crossroads (share 40%)	30	20	60	20	45

victims is smaller. It is not yet clear whether the target regarding serious injuries will also be achieved.

5. ORGANIZATIONAL AND FINANCIAL ASPECTS

The implementation of the sustainable safety measures requires long term planning and a stepwise approach. Road safety policy in the Netherlands is largely decentralised and local, regional and national road authorities have their own responsibility, budget and decision making procedures. Therefore, the involvement and concern of all relevant bodies is essential to realise a nationwide implementation of sustainable safety. Last but not least, a major operation such as this requires the acceptance and willingness of society in general.

In December 1997 the Dutch Minister of Transport and representatives of the three main road authority bodies signed an agreement for a "start-up programme" on sustainable safety which covered the period 1998–2002. During this period a number of measures were foreseen, mainly in the field of infrastructure supported by education, information and enforcement.

Firstly, all local, regional and national road authorities were required to recategorise their roads into one of the three sustainable safety categories (through-roads, distributor roads, access roads) and to attune the results with neighbouring road authorities. At this moment the large majority of the road authorities have a categorisation scheme which is compatible with the sustainable safety principles (see Figure 4).

Another important measure within the start-up programme includes the extension of the number and size of 30 km/h zones in residential areas with at least 12,000 km road length (i.e., up to 50% of the future 30 km/h zones) and the realisation of 60 km/h zones in rural areas with at least 3,000 km road length (i.e., 7% of the future 60 km/h zones), including infrastructure measures to support the overall speed limit at the most dangerous spots. The Dutch Ministry has made funds available to

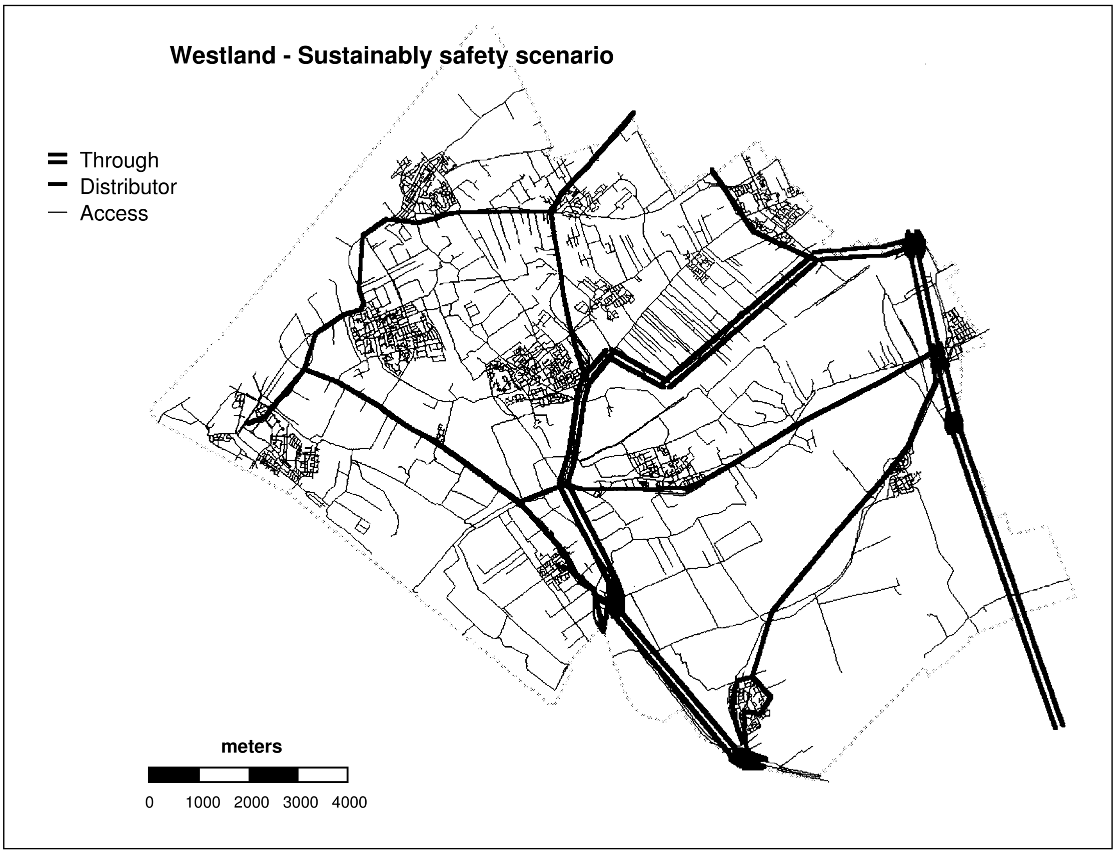

Fig. 4 An example of a categorised rural road network

support the authorities financially. The claims on the funds up to now indicate that road authorities have far advanced plans to realise a large number of these zones.

Education, communication and information are also an aspect that is emphasised in the start-up programme. First of all to ensure that measures are acceptable for the users and secondly to prepare road users on the their traffic participation and to realise the potential safety effects of a sustainable safe traffic system.

Now, just over two years after signing the agreement, implementation is in full progress and plans are being made on how to continue and extend the implementation after 2002. The ultimate aim is to have realised a fully sustainable safe traffic system by the year 2030. This target date is not arbitrary, but reflects the average length of life of road infrastructure. Clearly, the sustainable safety operation is very costly. SWOV estimated that full implementation of the sustainable safety principles would require around US$ 35 billion. By far the largest investment is needed for the reconstruction of existing infrastructure to fulfil the sustainable safety principles. The direct costs can be reduced markedly by having the reconstruction work to coincide with regular maintenance work. Given the average life of road infrastructure, in a period of around 30 years all roads could have been treated.

These days, the Dutch road authorities spend approximately US$ 1.5 billion on major and minor maintenance work annually. This means that the realisation of sustainable safety could be paid by merely redirecting existing budgets and would not rely on additional financial resources. Cost-benefit estimates[3] indicate that the usual government standard of 4 per cent return on investment is easily met by the potential reduction in road traffic victims and related costs.

6. CONCLUDING REMARKS

In the past, large risk reductions were realised by specific road safety measures, targeted at high risk groups and high risk behaviour. However, more recently it became clear that new, innovative efforts were required to be able to continue the declining trend in accident risk and to reach the road safety targets for 2010 despite the expected growth in mobility. Such an innovative approach is thought to be found in the principle of sustainable safety. In a sustainable safe traffic environment, road infrastructure is designed in such a way that the chance of an accident occurring is very limited. If an accident cannot be prevented, the chance of serious injury will be markedly reduced. Road network and road infrastructure measures are supported by education, information and enforcement.

The sustainable safety policy is a very promising approach. Whereas many of the elements and principles are not particularly new, the power of sustainable safety is in a consistent application, network-wide. The sustainable safety policy is in principle a cost effective approach which brings the Dutch road safety targets into reach. A rather conservative estimate of the sustainable safety effects indicates that in 2010, with an increase in car mobility of 45 per cent between 1998 and 2010, the Netherlands will be faced with 770 road traffic fatalities. This almost equals the targeted 50 per cent reduction of the 1986 level. The overall reduction in traffic casualties will be smaller. So far, it is not sure whether the targeted 40 per cent reduction in serious injuries is also feasible.

Clearly, the programme is very ambitious and requires the involvement and concern of all relevant bodies, not only of the local, regional and national road authorities, but also of society in general. In practice, a fully sustainable safe traffic system is still far away. In the discussions on the actual implementation financial and land use arguments are being used to choose, at least temporarily, for a less optimal solution. This is particularly true with regard to distributor roads which require according to the sustainable safety principles, separate facilities for cyclists and agricultural vehicles. This is expensive and requires space which is not always available. With regard to rural access roads, a lack of social acceptance of, in particular, speed reducing measures as well as the length of the network of this type of roads hinders a full sustainable safety solution in the short term. The financial arguments are logical if one considers the fact that the benefits of the investments only indirectly find their way back to those who made them.

Nevertheless, the developments so far show that the sustainable safety philosophy initiated a new élan in the road safety community. Road safety has got a more central place again in the discussions on road transport issues, everywhere road safety measures are being taken to contribute to the realisation of a sustainable safe environment.

The quantitative road safety targets, as applied in the Netherlands, most likely contributed to these positive developments. Or, as Wegman and Mulder[3] state: "Quantitative road safety targets result in quality-improvement of the road safety policy. Targets lead to targeted programmes. Targeted road safety programmes create pressure to monitor and assess recent developments and road safety programmes and, therefore, to continue effective programmes and stop ineffective ones. Having set road safety targets and observing trends that these targets would not be reached by continuing existing policies, created a sound breeding ground for developing a new vision on road safety policy in the Netherlands (towards a sustainable safe road traffic system) and encouraged support from key stakeholders."

It was estimated that the successful implementation of the sustainable safety policy would indeed result in the targeted 50 per cent reduction in road traffic fatalities in 2010 compared with 1986, even when the number of vehicle kilometres double. Whether this will actually be realised largely depends on the success to redirect road traffic to the safest roads and to reduce the accident risk on each of the road categories and in particular on the rural and urban distributor roads and access roads. Setting intermediate targets in terms of the distribution of motorised traffic over the road categories and in terms of the accident risk per road category (in addition to the overall quantitative targets) is considered helpful to focus and target road safety measures further.

The application of road safety targets, carefully monitoring and analysing the road safety statistics, the consistent application of the general principles of sustainably safety, i.e., monofunctionality, homogeneity and predictability are all considered to be relevant for improving road safety in any country of the world. Clearly, individual measures and their priority as well as the organisational framework and financial solutions have to be reviewed to ensure optimal tuning to national conditions and circumstances.

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